fields are also evident, so that the Department of Zoology is in the happy position on the one hand of being able to eater for a wide range of specialist activities, and on the other of maintaining varied and worthwhile field courses for its students.

Students and staff have reacted to these opportunities with enthusiasm. At this point it is important to emphasize that the station and its facilities were not taken over ready-made for research workers to walk into and use as a Credit is given elsewhere to those who base. translated an idea into a site and buildings. There were many others whose enthusiasm and labour made the building usable in the early stages of the Rottnest studies. The present day student and research worker likewise helps where he can, but he should be aware that there were others before him. A list of workers contributing to Station activities (research and otherwise) is given at the end of these reports. Of these the following (in alphabetical order) were forerunners who should be doubly men-tioned: J. Barker (neé J. Buttle), S. Barker, George, Hodgkin, Lee, Littlejohn, Main, Malcolm (and Mrs. Malcolm), Milward, Rudeforth, Sharman, Shield, and P. Woolley.

The form of these reports has been dictated by the necessity of fitting a large amount of different kinds of information into the one small Journal part. Accordingly all references concerning Rottnest Island have been collected ir a separate Bibliography and only those outside this scope, but necessary to a particular report. have been included with that report. Also. information with regard to individuals named in these reports has been given separately. There has been some duplication but only where this is necessary for clarity. Perhaps some helper may have been overlooked in the rush of preparation. If so I tender my apologies in advance.

In conclusion I would like to offer my personal thanks to all who have co-operated in this most rewarding venture. Elsewhere the financial contributions of the University, State Fisherics, and Australian Academy of Science are acknowledged. It is pleasing to me personally to here acknowledge the moral support and generous financial backing of the C.S.I.R.O Executive in the carrying out of our marsupial research programme.

H. WARING. Professor of Zoology.

10.—Rottnest Island as a Location for Biological Studies

The choice of Rottnest Island as a research centre arises from certain obvious advantages. e.g., the ease of access and the abundance of the quokka, the marsupial around which so much of the research has centred. The titles of the accompanying papers could suggest that there is nothing further to be said on the problems inherent in an insular situation. This may be so, yet, as will be mentioned below, the solutions of problems attacked on Rottnest have a potential application to continental situations which would not usually be considered as having anything in common with an island fauna. It thus seems desirable to give the general background and aspirations of the research a little more discursive treatment than will be given in other papers of this series in order that the full implications of the work can be appreciated.

Even a superficial acquaintance with the terrestrial fauna of the western portion of Australia poses a number of problems all of which centre around the distribution of animal species at the present, during the historical, the prehistorical and geological past. Many of the extant terrestrial animals cspecially the mammals have disjunct or restricted distributions which give every impression of being relicts of wider ranges. Perusal of the records of occurrence in the historical past confirm their relict nature for one soon discovers not only the wide extent of the former range but also the number of species which have become entirely extinct. Commonly such range restriction and extinction are ascribed to habitat destruction following the advent of European-type culture in Australia as well as the impact of introduced predators such as foxes or herbivores such as rabbits. However, this cannot be the whole story for some species of mammals apparently became extincbefore settlement was extensive and certainly before foxes and rabbits were present. The suspicion that European man with his associates was not the sole agent of extinction i: strengthened when one studies the cave deposit: along the Western Australian littoral. Here, in extensive deposits (mostly originating from ow pellets though there are many remains of large: animals), are an immense number of specimen: of species which are either no longer found in the vicinity or are entirely extinct.

Glauert was (1910, 1912, 1914, 1948) the firs to work these deposits and more recently Lundelius has surveyed caves over a much widel geographical area and, although this latter worker has as yet published no C14 dates, there is every indication that faunal changes have proceeded throughout the deposits to the superficial zone and these must be considered as within historical times. Many of the bones collected by Glauert and Lundelius (1957) are con-specific with species now restricted to the wetter south-east of Anstralia. The pre-historio and geological evidence thus suggests that envirportant factors, as opposed to man-made habitat changes, have perhaps played an important part in the range reductions and extinctions witnessed in the past 100 years or so.

Students of climatic change have proposed this mechanism repeatedly to account for disjunct or relict distributions in the Australian fauna Some workers suggest a great aridity at about 5,000 years ago while others disagree and Tindale points out that because of the uniqueness and sensitivity of some relict populations the climate could not have been much more arid in the recent past than it is at present. The apparent continuity of the process of species extinction from Pleistocene time to the historic past might be taken as supporting Tindalc (1955). The question is open. However it is quite clear that we will gain no real understanding of the faunal depauperisation until something is known of the way species react to deteriorating environmental conditions. As the accompanying papers show, it is as a dcteriorating environment that Rottnest offers such a valuable experimental "laboratory."

But Rottnest is not the only such "laboratory"; there are a number of other islands along the W.A. coast extending from the vicinity of Shark Bay to south of Esperance. These contain relicts of Plcistoccne faunal assemblages which were cut off from the mainland with the eustatic rise of the seas at the close of the Pleistocene. Some of these islands, e.g., the Abrolhos, contain fauna which is unknown on the adjacent mainland but is found several hundred miles to the south. Others, e.g., Rottnest, contain a fauna which is represented on the immediately adjacent mainland. It is the presence of a similar fauna on the adjacent mainland that affords one of the great research assets of Rottnest and this, plus the fact that the Island is large enough for local island populations to be developed, has meant that, potentially, both intra-island populations as well as island versus mainland populations could be compared.

Clearly if Rottnest has been isolated since the close of Pleistocene we might expect to find some changes in the fauna. The headings under which changes might be expected can be listed as follows:-

- (a) Those related to survival in a deteriorating cnvironment.
 - i. No change but wide individual tolerance which has not yet been exceeded by island environment, i.e., Rottnest animals similar to mainland.
 - ii: A significantly different range of tolerance in the island animals; this presumably produced by natural selection.
 - iii. A significantly different set of ranges of tolerance within the island population; this again presumably produced by selection.
- (b) Those related to cvolutionary differentiation in geographical isolation.
 - i. Morphological differentiation.
 - ii. Genetic isolation, e.g., sterility in island x mainland matings.
 - iii. Behavioural differences, e.g., male call differences in frogs,

For a profitable analysis in terms of the foregoing we need rather idealised animals which are amenable to morphological, physiological and experimental analysis. Fortunately, Rottnest contains four vertebrate species which, in varying degrees, fulfil the ideal, these are:-

The quokka (Setcnix brachyurus) and the frogs Heleioporus eyrei, Hyla raniformis and Crinia insignifera. The last mentioned species affords a good illustration of the kind of population changes which are possible. This species is polymorphic with a phenotypic frequency of the morphs on the mainland of: Striped, 0.37; lyrate, 0.37; and patternless. 0.26. On Rottnest patternless animals are not found and the rcmaining two morphs are equally frequent. In this case, if we assume that individual morphs and morph frequencies in the population have an adaptive significance then we have a measure of the magnitude of the changes which may be expected in other non-polymorphic populations. Nevertheless the principal research target has been the quokka which offers an opportunity for investigating the possible causes of marsupial extinction which had been so widespread during Quaternary time. There is no doubt that the study has lived up to expectations and it is now possible to use the data in hand as a basis for analogous reasoning when studying other macropod marsupials.

So much for theorising and speculation. The results, though not yet applicable directly to studies of faunal extinction generally have application to other fields, viz.: (i) Conservation and (ii) Pest Control.

(i) Conservation.-Many fauna reserves are of necessity "islands" in the sense that they are areas of country usually unwanted for either agricultural or pastoral pursuits. Because of their size and insular nature most will dcteriorate as areas containing representative natural habitats. To these situations the information that is coming from the Rottnest studies, especially as that relates to marsupials, has an application far wider than might be expected when it is viewed simply as a study of an island population (Main, 1956).

(ii) Pest Control.—From the inception of European settlement various marsupial species have been regarded as pests. Usually this has meant an active policy of extermination which in most cases has been successful from the settlers' point of view, with the result that the offending species has become totally or locally extinct. However, there are a few exceptions to this state of affairs, especially under pastoral conditions, where pest species have prospered even under widespread hunting and poisoning as well as in the presence of environmental changes caused by gross pastoral over-grazing. These successful species are the other side of the problem of extinction and require as much study as the threatened species. As a result of the Rottnest work on a small amenable species it is now possible to proceed in these studies on the less amenable species knowing that there are sufficient data from which general research programmes can be formulated. Such work has begun on the mainland.

A. R. MAIN.

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